

SECTION 02840 – PERMANENT JET BLAST DEFLECTOR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The General Provision of the contract, including the General Provisions for Construction Projects (2016), Special Provisions, and General Requirements of the Specifications, apply to the work specified in this section.

1.2 SUMMARY

- A. This Section includes the design, fabrication, erection, and certification for a complete Jet Blast Deflector (hereafter referred to as JBD).
- B. The JBD manufacturer shall furnish the final design, material, labor, and equipment to fabricate and erect the JBD.
- C. At project closeout, the JBD manufacturer shall furnish As-Built Drawings of the installation, Operation and Maintenance Guidelines, and a Performance Guarantee/Warranty Certificate approving the materials and installation.
- D. All civil work, including paving and foundations, is specified in other sections.
- E. Electrical work, including any required grounding, lightning protection, or lighting, is specified in other sections.

1.3 REFERENCES

- A. Section 02610, Concrete for Miscellaneous Structures
- B. Section 02820, Retaining Walls
- C. Section 16125, Installation of Airport Lighting System

1.4 SUBMITTALS

Prior to commencing the Work in this Section, the Contractor shall submit the following information as according to Section 01300, Submittals.

- A. Quality Assurance Documents: The JBD manufacturer shall submit all quality assurance requirements listed in Sections 1.5-B and 1.5-C (Quality Assurance) for approval.
- B. Upon execution of contract, the approved JBD manufacturer shall submit the following:

1. Shop Drawings: Provide assembly and installation drawings detailing location and overall dimensional information, materials, and finish details of the JBD. Drawings shall include details of the structural frame members and major assembly/subassembly details for the JBD structure, including plans, elevations, and sections. Show anchorage and accessory items. Drawings shall be stamped by a qualified Professional Engineer licensed in the State of Hawaii.
 2. Foundation Design Criteria: JBD manufacturer shall furnish the anchor loads and locations, as well as all miscellaneous requirements for foundation design.
 3. Structural Calculations: Provide structural design calculations for the JBD structure, including structural connections, deflecting surfaces, and anchors, prepared and stamped by a qualified Professional Engineer licensed in the State of Hawaii or certified by the Structural Engineering Certification Board. Calculations shall be submitted for each major frame system and shall comply with the 2021 State of Hawaii Building Code.
 4. Professional Engineer Qualifications: Documentation of past experience in accordance with Section 1.5-B (Quality Assurance) shall be provided with the submittal package.
- C. At project closeout, the approved JBD manufacturer shall submit the following:
1. Mill Certificates: Provide mill certificates for all steel used in the manufacturing of the JBD.
 2. Performance Guarantee/Warranty Certificate: Provide a written copy of the manufacturer's guarantee or warranty certifying the workmanship, materials, installation, and performance of the JBD for a period of one (1) year. See Section 3.3 (Erection) for JBD manufacturer supervision requirements.
 3. As-Built Drawings: Submit as-built drawings of completed work in accordance with requirements of the specification as indicated in Division 01.
 4. Operation and Maintenance Manual: Provide an operation and maintenance manual for the JBD and associated components, including inspection intervals and guidelines.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: The JBD structural members, fasteners, deflecting surfaces, and anchorage shall be procured from a single source responsible for design, manufacture, supply, and issuance of performance guarantee/warranty certificate in accordance with Section 1.4-B and 1.4-C (Submittals) of this specification.

- B. Professional Engineer Qualifications: Drawings and calculations shall be stamped by a Professional Engineer with experience of at least five (5) past jet blast deflector projects rated for taxi/breakaway operations.
- C. Alternate Manufacturers: To be approved as an alternate manufacturer, the following information shall be submitted-to and approved-by the Owner prior to submitting a bid (see Section 1.4-A).
 - 1. Results of full-scale field proof tests in which the proposed JBD was subjected to the specified aircraft operating at taxi/breakaway power settings. Computer simulations may be used as an acceptable alternative to full-scale proof tests, provided the computer simulations are completed by a qualified (competent) engineer/scientist with proper credentials necessary for these type simulations. Proper credentials require graduate studies in thermo-fluid analysis, professional or academic knowledge of jet engines/turbomachinery theory, as well as experience using computational fluid dynamics to model jet engines/aircraft in ground effect.
 - 2. Results of full-scale smoke dispersion tests demonstrating that smoke and gases are deflected in an upward direction, with evidence of no smoke dispersal behind the deflector. Video footage and test report shall be provided. Alternatively, computer simulation data (per the above stipulations) may be provided in lieu of full-scale smoke dispersion tests to demonstrate the efficacy of the JBD at deflecting the jet blast.
 - 3. Evidence of satisfactory operation of at least five (5) installations of the proposed model, each with at least five (5) years of actual field service of continued use with similar aircraft, power settings, and engines.
 - 4. Detailed structural design analysis of the proposed JBD showing loads and stresses in structural members, bolted connections, deflecting surfaces, and anchorage, using the worst-case aircraft velocity profiles as the calculated pressure for load calculations. Structural calculations shall comply with the 2021 State of Hawaii Building Code.
 - 5. Design drawings of the proposed JBD demonstrating that the deflector meets all design and material specifications listed in Parts 1 and 2 of this specification.
 - 6. Evidence that the JBD designer/manufacturer is ISO 9001:2015 registered.
 - 7. Evidence that the JBD designer/manufacturer has a combined commercial general liability and excess coverage of \$10 Million (minimum) with products/completed operations coverage. The JBD designer/manufacturer shall also provide evidence of professional liability coverage of \$1 Million (minimum).

1.6 DESIGN CRITERIA

A. Aircraft

This JBD shall be designed for all commercial aircraft operating at taxi/breakaway power settings with no aircraft tail closer than 35 feet from the JBD leading edge and no engine nozzle closer than 60 feet from the JBD leading edge. The JBD shall also be designed for B777-200 aircraft operating at high breakaway and takeoff power settings with no aircraft tail closer than 350 feet from the JBD leading edge. Design exhaust velocity is 140 mph and shall be converted to pressure using standard day conditions. The effects of high-bypass engines and the effects of high-centreline engines typical of wide-body aircraft shall be considered in the design of the JBD.

B. JBD Description

The JBD deflecting surface shall be vertical, cantilevered, corrugated type with corrugations running in the horizontal direction (see Note 1). The upper 2 feet of the JBD located behind the aircraft (see Sections 1.6.D & E) shall incorporate a canted surface leaning toward the runway surface to improve jet exhaust discharge angle(s). Performance of the JBD shall be substantiated via computer modelling or scale modeling. Deflecting surfaces may not use concrete or perforated (or expanded) metal (see Notes 2 and 3). Deflecting surfaces shall be rigidly supported by bolted structural steel post assemblies spaced at 6'(maximum) centers. Deflecting surface panels shall be directly supported by steel post assemblies. The JBD shall be configured per Sections 1.6.D & E, consisting of models V1214-6FR & V4-6FR or approved equals. Any alternatives shall strictly comply with all of Section 1.4 (Quality Assurance) conditions in order to qualify as an approved equal.

Notes:

1. Deflecting surfaces composed of flat metal or corrugations of lower section modulus than specified (see Section 2.2-B) shall not be used due to potential 'oil-canning' effects, which may lead to early fatigue failure.
2. Blast deflectors composed of concrete shall not be used due to the potential for surface spalling, which may lead to Foreign Object Debris/Damage (FOD) hazards.
3. Perforated or expanded metal (a.k.a. mesh) deflectors shall not be used since passage of high velocity engine exhaust through the deflector is not conducive to full protection immediately behind the mesh, especially at lower elevations. In the case of expanded metal, there is potential for entrained particulate (sand, stone, etc.) to pass through the deflector near ground level and become airborne.
4. In addition to the aerodynamic performance, the proximity of the JBD to the active runway requires the following frangible elements to be incorporated to the design as a minimum:

- a. Breakaway bolts: The JBD system shall incorporate breakaway bolts at the base of the structure, as close as practical to the foundation finished surface. Acceptable products shall have been previously approved by the FHWA via NCHRP Report 350.
- b. Modularity: The JBD system shall be constructed such that aircraft impact will “open a window” for the aircraft to pass through, and thus minimizing parts of the structure from wrapping around or entangling the aircraft.
- C. JBD Performance: The JBD shall reduce jet blast velocities at ground level behind the JBD to a maximum of 35 mph. The jet blast envelope shall be deflected upward at a minimum angle of 30° under no wind conditions.
- D. Layout: As shown on plans
- E. Height: 14 feet (nominal) & 4 feet (nominal).
- F. Foundation: The JBD shall be incorporated into the reinforced retaining wall system at the airport property boundary. Thus, JBD anchorage shall be verified for strength/stability, taking into account the retaining wall design and reinforcing steel configuration. Retaining wall designer and JBD designer/supplier shall sign off on coordinated design details prior to construction.
- G. Connections: For ease of assembly and to minimize construction time on the active airfield, all field connections shall be bolted. Field-welding is not permitted. The design of the structure shall maintain a reasonable degree of modularity should components require future repair or replacement.
- H. FOD Considerations: Fastener assemblies used in the construction of the JBD shall include adequate locking mechanism(s) to prevent from working loose during continued, normal use of the structure (subject to JBD manufacturer maintenance guidelines).
- I. Loading: The JBD shall be designed to withstand exhaust velocities from all aircraft specified in Section 1.6-A. Engine exhaust velocity shall be converted into pressure using standard day conditions and shall be applied normal to all deflecting surfaces. Code-level wind conditions in strict conformance with the 2021 State of Hawaii Building Code shall also be assessed to identify governing design criteria for all JBD structural components.

PART 2 PRODUCTS

2.1 JBD MANUFACTURER, OR APPROVED EQUAL

Blast Deflectors, Inc.
8620 Technology Way
Reno, NV 89521

2.2 STRUCTURE

- A. Vertical Post Assemblies: Structural steel shapes shall consist of ASTM A992 (minimum strength) steel and shall be cut and punched, as required. The upper, canted section of the JBD shall consist of ASTM A36 (minimum strength) steel and shall be cut and punched, as required. All field connections shall be bolted (no field-welding permitted). After shop fabrication, all individual structural steel assemblies shall be hot-dip galvanized to a minimum of 2 oz/ft² per ASTM A123.

Duplex Coating: Due to the corrosivity of the local microclimate, structural steel components shall be powder coated over the above-noted galvanizing to further optimize corrosion protection. The following minimum coating characteristics and standards shall apply:

Characteristic	Requirement
Powder Coating Type:	Polyester
Color:	RAL 7042 (Traffic Grey A)
Specific Gravity:	1.62 ± 0.05 per ASTM D5965
Target Thickness:	3 mil
Overbake Resistance:	100% per ASTM D2454
Salt Spray:	1,000 hrs minimum

- B. Deflecting Surface Sheets: Corrugated steel sheets shall be formed from 16-gauge (minimum) ASTM A924 sheet steel with 2 oz/ft² hot-dip galvanized coating per ASTM A653. Section modulus of formed sheets shall be a minimum of 0.196 in³/ft and shall be attached to frames with 3/8"-diameter bolts using half oval washers.

Duplex Coating: Due to the corrosivity of the local microclimate, sheets shall be powder coated over the above-noted galvanizing to further optimize corrosion protection. Sheets shall be provided in orange and white alternating pattern, with the aspect ratio of each band (height-to-width) being approximately 1:1. Orange and white colors shall be provided per the Aerospace Material Specification Standard (SAE-AMS-STD-595) in accordance with FAA AC 70/7460-1M. The following minimum coating characteristics and standards shall apply:

Characteristic	Requirement	
Powder Coating Type:	Polyester	
Colors:	EA 12197 (International Orange)	EA 17875 (Insignia White)
Specific Gravity:	1.56 ± 0.05 per PCI #4	1.60 ± 0.05 per PCI #4
Target Thickness:	3 mil	
Overbake Resistance:	100% per ASTM D2454	

Salt Spray:	1,000 hrs minimum
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- C. Fastener assemblies shall include adequate locking properties and shall be designed to withstand direct jet blast. Where applicable, the following shall be used as a minimum for strength, locking, and anti-corrosion characteristics:

Fastener Component	Bolt Nom. Diameter $\geq \frac{1}{2}$ "	Bolt Nom. Diameter $< \frac{1}{2}$ "
Bolts:	ASTM F593 (316 Stainless)	ASTM F593 (316 Stainless)
Flat Washers:	316 Stainless	316 Stainless
Lock Washers:	ASME B18.21.1 (Where Applicable)*	N/A
Nuts:	ASTM F594	ASTM F594, Nylon-Insert Locking
Finish:	ASTM A380 (Stainless Steel)	ASTM A380 (Stainless Steel)
Half Oval Washers:	ASTM A36 steel, hot-dip galvanized per ASTM A123 to 2 oz/ft ²	
*Nuts and/or washers shall incorporate locking component to withstand vibrations induced by direct jet blast, thus preventing FOD; configuration shall be determined by the supplier using proven methods. Technical details of locking component shall be submitted within item 1.4-B.3 of these specifications.		

- D. Anchor Bolts: Cast-in-place anchors shall be designed per ACI 318-14. Approved anchors are 1-inch-diameter, ASTM A193 B7 threaded rod with embedded heavy hex head in hot-dip galvanized finish. Anchors shall be supplied by the JBD manufacturer, to be cast-in-place by the retaining wall contractor. Anchor shall not be subject to any loads for concrete that has cured for less than 7 days.

Duplex Coating: Due to the corrosivity of the local microclimate, all exposed surfaces on the anchor bolts and breakaway bolts (see Section 1.6.B.) shall be field-painted over existing/original hot-dip galvanized finishes using zinc-rich paint after installation. Zinc-rich paint shall contain greater than 93 percent pure zinc by weight and shall comply with Mil-P-21035 and Mil-P-26915. A minimum of two (2) coats shall be applied in the field to each anchor bolt and breakaway bolt assembly.

- E. Repairs to Powder Coating Finishes: The JBD designer/supplier shall provide color-matched touch-up paint for all supplied powder-coated colors/surfaces. Touch-up paint shall be approved for use by the JBD designer/supplier's selected powder coating applicator(s). Touch-up paint shall only be applied by the JBD designer/supplier or by an approved representative thereof. Touch-up paint shall comply with the following minimum requirements:

Characteristic	Requirement
Composition:	Acrylic-Modified Alkyd Enamel
Color(s):	Refer to Section 2.2.A. & 2.2.B.
Solids % by Weight:	40%
Hardness:	HB per ASTM D3363
Adhesion:	5B per ASTM D3359

For areas in which the powder coating finish has been removed down to the hot-dip galvanizing or to bare metal, a zinc-compatible primer shall be used prior to applying alkyd-based paint. The following primers are known to be compatible with galvanized steel and alkyd paint: Dunn-Edwards ULTRASHIELD, Carboline Sanitile 120, Carboline Galoseal, Rust-Oleum XIM UMA, Devco Devcyl 1440. JBD designer/supplier shall submit selected product data sheet for approval by the Owner.

Application: Primer and touch-up paint shall be applied in accordance with the paint manufacturer's written instructions. The following thicknesses shall be achieved for each field-applied coating:

Field-Applied Coating	Dry Film Thickness
Primer (where required):	3 mil (minimum)
Touch-up Paint:	3 mil (minimum)
Total Coatings:	6 mil (minimum)

A properly-calibrated coating thickness gauge shall be used to ensure all field-applied dry film thicknesses are achieved. Calibration records for the coating thickness gauge used for field measurements shall be provided by the JBD manufacturer (or approved representative thereof) upon request.

2.3 FABRICATION, GENERAL

- A. Produce metal fabrications from materials of approved size, thickness, and shapes as required. Work to dimensions indicated on approved shop drawings using proven details of fabrication and support.
- B. All fabrications shall be produced with precise angles and straight, sharp edges.
- C. Material shall be cut, sheared, drilled, and/or punched cleanly and accurately. Remove all burrs from edges and holes.
- D. Remove any remaining sharp or rough areas on exposed surfaces prior to galvanizing.

2.4 PRODUCT MARKING

JBD manufacturer shall provide signage indicating manufacturer name, model number, power rating, usage restrictions, and project information/identifier. Sign(s) shall be securely-bolted to the back of the completed structure.

PART 3 EXECUTION

3.1 SITE CONDITION

The JBD manufacturer shall inspect the site prior to beginning work and notify the Owner of any deficiencies. Installation may not proceed until unsatisfactory conditions have been corrected.

3.2 MATERIAL STORAGE AND HANDLING

- A. Store all JBD materials in approved areas, protected from the elements, and in a manner that prevents any damage, distortion, or deterioration. Keep deflecting surface sheets and steel members off ground using pallets, dunnage, platforms, or similar supports. Do not expose nested or stacked materials to water or moisture.
- B. Surfaces showing iron stain or red rust shall be retouched or re-galvanized to the satisfaction of the contracting officer. See Section 2.2-E (Structure) for details for the galvanizing repair paint.

3.3 ERECTION

- A. The JBD manufacturer shall observe and supervise the construction of the JBD and, upon satisfactory completion, the JBD manufacturer shall issue the performance guarantee/warranty (see Section 1.4-C).
- B. Set all cast-in-place anchors at the locations provided on approved shop drawings using templates and/or formwork to ensure precision and accuracy. Where applicable, install all post-installed concrete anchors in accordance with anchor manufacturer's written instructions. Use steel templates during drilling/setting of post-installed anchors to ensure accurate positions.
- C. Set steel post assemblies accurately at the locations provided on approved shop drawings, and in accordance with applicable American Institute of Steel Construction (AISC) standards.
- D. Provide temporary guys and/or braces, as required, to support structural elements during erection.
- E. Tighten all fasteners to the torques specified by the JBD manufacturer.
- F. Field-executed thermal cutting or welding is not permitted.
- G. Touch up any damaged galvanized surfaces with galvanizing repair paint (see Section 2.2-E for galvanizing repair paint product requirements). Follow paint manufacturer's written instructions for surface preparation and application.

3.4 PERMITS

The general contractor shall be responsible for obtaining approval for the design of the JBD structure and associated foundation, and any required building permits.

3.5 INSPECTION

- A. The JBD manufacturer and the Owner, or designated representatives thereof, shall visually inspect the completed installation to ensure that all work has been completed in an acceptable manner. Special care shall be given to the inspection of the JBD for loose material and missing fasteners.
- B. Once any noted issues are corrected to the satisfaction of both parties, an acceptance letter or certificate of completion shall be signed by the representatives of the JBD manufacturer and the Owner who participate in the inspection. Final acceptance/certification by the JBD manufacturer and Owner shall be obtained in order to validate the performance guarantee/warranty for the JBD structure.

3.6 CLEANUP

- A. Following completion of construction and related inspections, and prior to any aircraft operation, the JBD manufacturer representative(s) shall remove all associated construction materials, equipment, and debris from the jobsite.
- B. Prior to aircraft operation, the Owner is responsible for thoroughly sweeping the surrounding areas and inspecting for FOD.

3.7 TESTING

Proof testing of taxi/breakaway fences is not required.

PART 4 MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT

- A. All work under this section will not be measured for payment.

4.2 BASIS OF PAYMENT

- A. Items covered by this section will be paid by lump sum. The contract price paid shall be for full compensation for furnishing and placing all materials and all labor, equipment, tools, and incidentals necessary for each of the construction phases. Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Unit</u>
02840.1A	Permanent Jet Blast Deflector (Phases 0 through 3)	Lump Sum

END OF SECTION 02840